valve **1**, and (e) operating pump **30** in direction B to move fluid from the sampling line **24** back into the vessel **20** without removing any fluid from container B-**1**.

[0033] FIG. **5** schematically shows the sampling system incorporated with an automated control system **70** configured to automatically control operation of the valves of the flow control system and the pump **30**. The automated control system **70** includes a programmable automation controller ("PAC") **72**. A suitable PAC is available from National Instruments Model No. sbRIO 9641. The PAC **72** includes a 24 volt digital output **74**, which is connected to each of the valves **1-14** (the connection of digital output **74** to valves **7-14** is not shown in FIG. **5** so as to avoid obscuring the drawing). The pump **30** is connected to the digital output via a DPDT (double pole double throw) relay **78** and a DPST (double pole single throw) relay **76**. In the illustrated embodiment, the PAC **72** and the relays **76**, **78** are connected to a 24 volt power source.

[0034] The PAC **72** is programmed with a sequencing algorithm, such as an algorithm that will implement the process shown in FIG. **4**. Initiation of the sampling sequence may be programmed into the PAC **72** so as to be automatic, or the sampling sequence may be initiated by a user via a user interface. In one embodiment, each of the valves **1-14** is an electronic pinch valve that is normally in a closed state and may be opened by a signal generated by the PAC **72** and output by the digital output **74**. As shown in the illustrated embodiment, the PAC **72** and digital output **74** generate a dedicated signal V**1**, V**2**, V**3**, V**4**, V**5**, V**6**, etc., for each of the valves **1-14**, respectively. The P**2** output, along with the controls of the DPST relay **76**, govern whether power gets to the DC motor of the pump **30**. The P**1** output, along with the controls of the DPDT relay **78**, changes the polarity of the power that gets to the DC motor of the pump **30** thereby controlling the direction of the pump. In an embodiment of the invention, the PAC effects a timing-based control of the valves and the pump to transfer a desired volume fluid, in one direction or the other, based on the volume of the sampling lines and the flow rate of the pump.

[0035] In an alternate embodiment, valves **5-14** of the flow control system are not connected to the PAC **72** and are not automatically controlled. In such an embodiment, the appropriate valves are open and closed manually. In still other embodiments, valves **5-14** are omitted from the flow control system altogether, and the appropriate flow control is achieved using clamps or hemostats at pinch points in the main and secondary sample tubing corresponding to the locations of valves **5-14** shown in FIGS. **1** and **2**. In a still further embodiment, shown in FIG. **6**, the flow control system includes a manifold **80** connected to the main sampling line **24**, and each of the sample containers B-**1**, B-**2**, B-**3**, B-**4**, and B-**5** is coupled to the sample manifold **80** via an associated three-way stopcock **82**, **84**, **86**, **88**, and **90**. Reference characters A, C, E, and G indicate pinch points in the secondary sampling lines were clamps are placed when the associated sample containers are removed.

[0036] An exemplary sampling sequence using the automated system **70** is described below.

[0037] Before the sampling sequence commences, each of the automatically-controlled valves **1-4** is closed and the pump **30** is not operating. Digital output **74** outputs an "off" or null signal for outputs V**1**, V**2**, V**3**, V**4**, P**1**, and P**2**. Valves **5-6** are closed, either manually or via an "off" or null signal from the digital output **74** of the PAC, or main and secondary sampling lines are clamped at pinch points corresponding to the locations indicated by valves **5-14**. The sampling sequence is initiated by a user at a user interface, or a pre-scheduled sampling sequence may be programmed into the PAC **72** for automatic initiation by the PAC **72**. To perform the sampling sequence, generally corresponding to step **54** in FIG. **4**, the PAC **72** opens valve **1** by changing signal V**1** to "on" and opens valve **4** by changing signal V**4** to "on" to open the sampling line **24**. Valve **5** is opened, either automatically or manually, or the clamp is removed from the pinch point **5**. Thus, the sampling lines are open from the vessel **20** to the first sample container B-**1**.

[0038] Signal P**1** is changed to "on" and signal P**2** is changed to "on" to operate the pump **30** in a forward direction to pump fluid from the vessel **20**, through the main and secondary sampling lines, and into the sample container B-**1**. At a first prescribe time lapse (ΔT**1**) following the initiation of the sample pumping sequence, the sampling sequence is terminated, and a forward flush (corresponding to step **58** in FIG. **4**) is performed. PAC **72** changes signal V**1** to "off" to close valve **1**, thereby terminating sample flow from the vessel **20**, and changes signal V**2** to "on" to open the valve **2** and vessel side vent line **32** to vent the vessel side of sampling line **24**. Signals P**1** and P**2** remain "on" to continue forward flow of the pump **30**, V**3** remains "off" and V**4** remains "on" to continue flow into the sample container B-**1** without drawing additional fluid from the vessel **20** thereby clearing fluid from the sampling line **24**. The length of the time lapse ΔT**1** for beginning the flush sequence is calculated from the tubing volume in the system, the desired sample volume (which may be input by the user), and the pump flow rate.

[0039] At a second prescribed time lapse (ΔT**2**) following initiation of the sampling sequence a reverse flush (corresponding to step **56** in FIG. **4**) is performed. PAC **72** changes signal V**1** to "on" to open valve **1**, thereby connecting vessel **20** to the sampling line **24**, changes signal V**2** to "off" to close valve **2**, thereby closing sample side vent line **32**, changes signal V**3** to "on" to open valve **3** to open the valve **3** and sample side vent line **34** to vent the sample side of sampling line **24**, changes signal V**4** to "off" to close valve **4**, thereby closing off the sample containers, and changes signal P**1** to "off" while keeping signal P**2** at "on" to cause a reverse flow of the pump **30** to pump any fluid remaining in sampling line **24** and dip tube **22** into the vessel **20** without pumping any fluid from the sample container B-**1**.

[0040] The sample sequence is terminated at a third prescribed time lapse (ΔT**3**) from initiation of the sampling sequence by turning all signals to "off", thereby closing valves **1-4** and stopping pump **30**. The second and third time lapses, ΔT**2** and ΔT**3**, are calculated from the tubing volume and the pump flow rate.

[0041] Sample container B-**1** is then removed by closing valve **5**, either manually or automatically, or by clamping the secondary sampling line at the pinch point corresponding to the location of valve **5**, and then cutting the secondary sampling line below the valve or clamp. To take the next sample, valves **6** and **7** are opened, or the user opens the clamps at pinch points corresponding to the locations of valves **6** and **7**, and valve **8** is closed, or the user clamps the tubing at a pinch point corresponding to the location of valve **8**. The sampling sequence is repeated as described above, and, after sample container B-**2** is filled and the sampling lines are flushed out, valve **7** is closed, or the secondary sample tubing is clamped